MUTCD Retroreflectivity Minimums

Requirements, Impacts,
Benefits, and Cost

1993 Congressional Directive

- FHWA has been researching minimum levels of retroreflectivity since 1993.

- Driver visibility studies from around the country contributed to the development of the proposed MUTCD change.

Proposed MUTCD Change

- **Standard:**

  Public agencies or officials having jurisdiction **shall** use an assessment or management method to maintain traffic sign retroreflectivity at or above the minimum levels established in the Guidance below.

Assessment or Management Methods

- Visual Nighttime Inspection
- Measured Sign Retroreflectivity
- Expected Sign Life
- Blanket Replacement
- Control Signs

FHWA Minimum Levels

Minimum Maintained Retroreflectivity Levels①

Sign Color	Sheeting Type (ASTM D4956-04)				Additional Criteria
	Beaded Sheeting			Prismatic Sheeting	
	I	II	III	III, IV, VI, VII, VIII, IX, X	
White on Green	W*; G ≥ 7	W*; G ≥ 15	W*; G ≥ 25	W ≥ 250; G ≥ 25	Overhead
	W*; G ≥ 7	W ≥ 120; G ≥ 15			Ground-mounted
Black on Yellow or Black on Orange	Y*; O*	Y ≥ 50; O ≥ 50			②
	Y*; O*	Y ≥ 75; O ≥ 75			③
White on Red	W ≥ 35; R ≥ 7				④
Black on White	W ≥ 50				—

① The minimum maintained retroreflectivity levels shown in this table are in units of cd/lx/m² measured at an observation angle of 0.2° and an entrance angle of -4.0°.
② For text and fine symbol signs measuring at least 1200 mm (48 in) and for all sizes of bold symbol signs
③ For text and fine symbol signs measuring less than 1200 mm (48 in)
④ Minimum Sign Contrast Ratio ≥ 3:1 (white retroreflectivity – red retroreflectivity)
* This sheeting type should not be used for this color for this application.

Bold Symbol Signs

- W1-1, -2 – Turn and Curve
- W1-3, -4 – Reverse Turn and Curve
- W1-5 – Winding Road
- W1-6, -7 – Large Arrow
- W1-8 – Chevron
- W1-10 – Intersection in Curve
- W1-11 – Hairpin Curve
- W1-15 – 270 Degree Loop
- W2-1 – Cross Road
- W2-2, -3 – Side Road
- W2-4, -5 – T and Y Intersection
- W2-6 – Circular Intersection
- W3-1 – Stop Ahead
- W3-2 – Yield Ahead
- W3-3 – Signal Ahead
- W4-1 – Merge
- W4-2 – Lane Ends
- W4-3 – Added Lane
- W4-5 – Entering Roadway Merge
- W4-6 – Entering Roadway Added Lane
- W6-1, -2 – Divided Highway Begins and Ends
- W6-3 – Two-Way Traffic
- W10-1, -2, -3, -4, -11, -12 – Highway-Railroad Advance Warning
- W11-2 – Pedestrian Crossing
- W11-3 – Deer Crossing
- W11-4 – Cattle Crossing
- W11-5 – Farm Equipment
- W11-6 – Snowmobile Crossing
- W11-7 – Equestrian Crossing
- W11-8 – Fire Station
- W11-10 – Truck Crossing
- W12-1 – Double Arrow
- W16-5p, -6p, -7p – Pointing Arrow Plaques
- W20-7a – Flagger
- W21-1a – Worker

Fine Symbol Signs – Symbol signs not listed as Bold Symbol Signs.

Special Cases

- W3-1 – Stop Ahead: Red retroreflectivity ≥ 7
- W3-2 – Yield Ahead: Red retroreflectivity ≥ 7; White retroreflectivity ≥ 35
- W3-3 – Signal Ahead: Red retroreflectivity ≥ 7; Green retroreflectivity ≥ 7
- W3-5 – Speed Reduction: White retroreflectivity ≥ 50
- For non-diamond shaped signs such W14-3 (No Passing Zone), W4-4p (Cross Traffic Does Not Stop), or W13-1, -2, -3, -5 (Speed Advisory Plaques), use largest sign dimension to determine proper minimum retroreflectivity level.

White on Green

- Overhead and Ground Mounted guide signs have different requirements.

- Divided into two groups based on the sign location.

Overhead Guide Signs

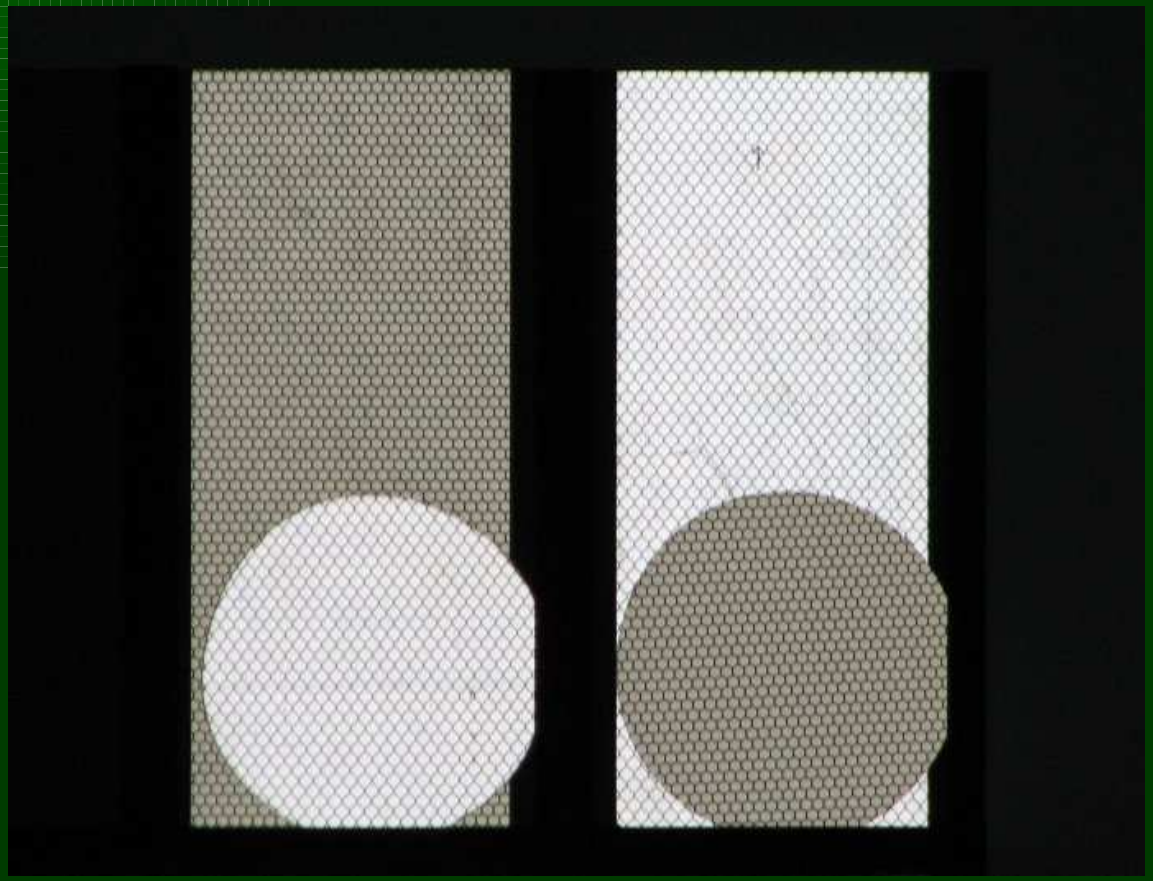
- Minimum R_A of 250 for White
- Minimum R_A of 25 for Green

Overhead Replacement Impact

- R_A of 250 for White is very high
- Type III beaded sheeting is not allowed for the legend
- Using Type VII, VIII, or IX sheeting could eliminate sign lighting

White Overhead Sign Sheeting

- IX R_A = 550
- III R_A = 275



White Overhead Sign Sheeting

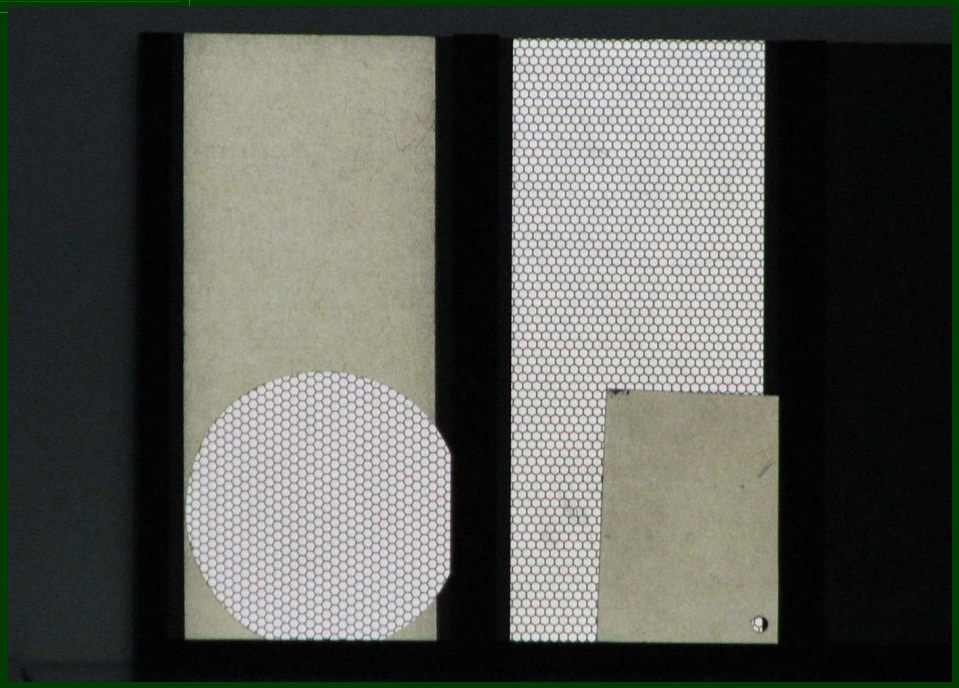
- Type IX vs. Type III Legend
- IX R_A = 550
- III R_A = 300

Ground Mounted Guide Signs

- Minimum R_A of 120 for White
- Minimum R_A of 15 for Green

Ground Mounted Impact

- R_A of 120 for White is somewhat high.
- Type III sheeting will easily meet this requirement.
- III R_A = 275
- I R_A = 105
- I R_A = 70



Black on Yellow/Orange

- Divided into two groups
- Bold Symbol and 48” Signs
- Fine Symbol Signs less than 48”

Bold Symbol and 48” Signs

- Minimum R_A of 50 for Yellow/Orange
- Bold Symbol Signs include:

Fine Symbol Signs less than 48”

- Minimum R_A of 75 for Yellow/Orange
- Fine Symbol Signs include text signs and all symbol signs not designated as bold.

Yellow/Orange Replacement Impact

- Minimum R_A of 50 or 75 for Yellow/Orange are both low.

- Hi-intensity sheeting insures that the sign has a long service life.

Black on Yellow/Orange

- The difference between 50 and 75 is almost negligible to the eye.
- This photo illustrates the difference between R_A values of 70 and 105.

White on Red

- Minimum R_A of 35 for White
- Minimum R_A of 7 for Red
- White must be 3 times more retroreflective than the Red
- So if a the R_A of a Red is 40, the White Sheeting must have an R_A of 120 or more

White on Red Replacement Impact

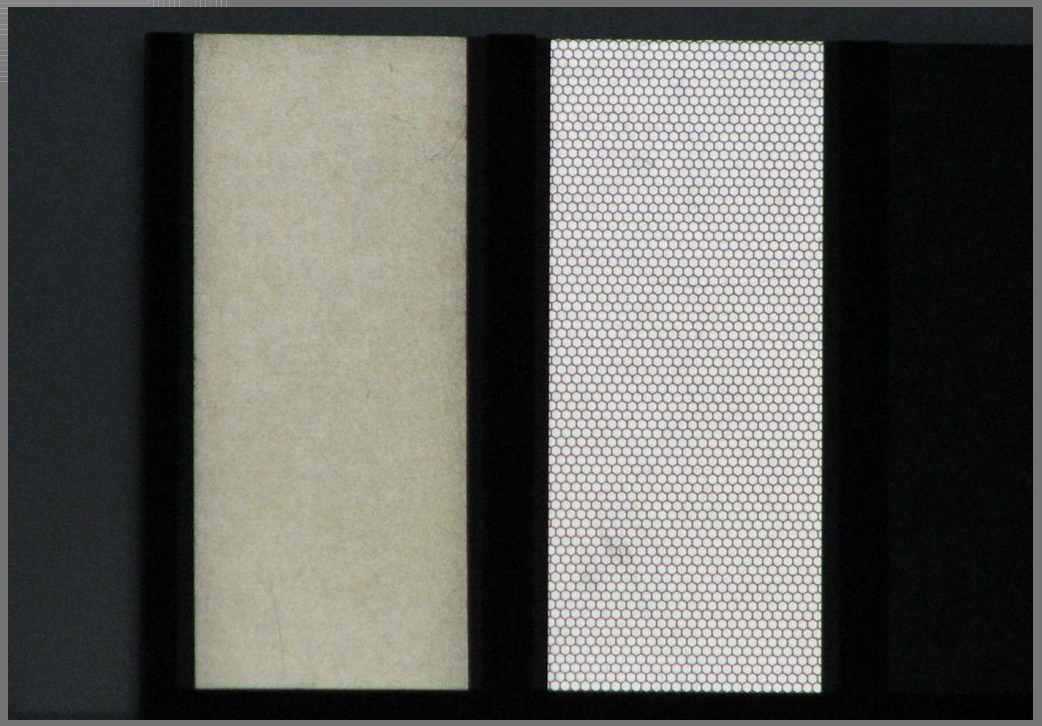
- Hi-intensity sheeting will easily exceed the minimum R_A values.
- The minimum contrast will be difficult to measure without a retroreflectometer.
- Red typically degrades faster than white, so if the initial values are 3:1, the contrast should not be an issue.

Black on White

- Minimum R_A of 50 for White
- Black is non-reflective

Black on White Replacement Impact

- An 80% loss in R_A would require a replacement.
- I R_A = 105
- III R_A = 275



Benefit: Visual Impact

- The minimum values provide sign luminance to more than 90% of drivers.
- This was done by establishing a 50% criteria for drivers over 55. 89% of nighttime drivers are under 55 years.

Replacement Impact: Cost

- 15-20 year anticipated sign life.
- Many signs will be vandalized or destroyed.
- Some signs will be replaced under projects.
- Replacements should not significantly increase due to the new minimums.

Annual Cost of 800,000 Signs

- If all signs require replacement every 20 years, the estimated annual cost is under $1.3 Million per division.
- Sign fabrication costs are estimated at $800,000 per year per division. One dollar per division per year for the total number of signs in the state.

Questions?